REMARKS

The Examiner's Office Action dated January 15, 2003 has been received and its contents carefully noted. The Applicant respectfully submits that this response is timely filed and fully response to the Office Action. By the above amendments, claims 6-10, 13 and 18 have been amended, new claims 19-24 have been added and claims 11-12, 14-17 have been cancelled. Consequently, claims 6-10, 13 and 18-24 are currently pending. In light of the above amendments and detailed arguments to follow, reconsideration of the currently proposed rejection is respectfully requested.

With regard to the Examiner's objection to claims 11-17 being substantial duplicates of claims 7-10, the Applicant's cancellation of claims 11, 12 and 14-17 and amendment to claim 13 is believed sufficient to overcome the objection.

With regard to the rejection of claims 6-18, under 35 U.S.C. 102(b), as being anticipated by the teachings of Brown et al. ('113), this rejection is respectfully traversed.

In the prior art discussed in the specification, page 2, line 11, to page 3, lines 23, when an organic polymer film usable as the interlayer dielectric film of VLSI is porous, the relative dielectric constant of the film is lowered. However, a porous interlayer dielectric film has a new problem in that the mechanical strength, the thermal resistance, and the adhesion to a substrate of the interlayer dielectric film are also lowered.

In order to solve the above problems, the method for forming the semiconductor device in the present invention (claim 18) includes the step of forming the interlayer dielectric film made of the three-dimensionally polymerized organic polymer having a number of molecular level pores inside. The interlayer dielectric film is formed by polymerizing initially cross-linking molecules having a three-dimensional structure and then cross-linking molecules having a two-dimensional structure.

The cited reference Brown et al (column 3-7) teaches an integrated circuit device having a metal wiring and including a dielectric material, which functions as an interlayer insulating film and is composed of a reaction product of an organic polysilica and a trialkoxysilylalkyl end-capped polyamic ester. Since the dielectric material in grown includes silica (SiO_2) and alkoxysilyl (Si-OR), the interlayer insulating film is composed of an organic and inorganic hybrid film. Moreover, as shown in the chemical formula of Brown et al. (spanning columns 7-8), since the polyamic ester has a straight chain structure, a three-dimensional structure having molecular level pores inside cannot be formed.

On the other hand, the interlayer insulating film of the presently claimed invention is an organic polymer, i.e., <u>it includes no inorganic component such as silicon</u>. Moreover, the interlayer dielectric film is a <u>three-dimensionally polymerized organic polymer</u> formed by polymerizing first cross-linking molecules having a three-dimensional structure and second cross-linking molecules having a two-dimensional structure <u>yielding a structure having molecular level pores</u>. Finally, since the polyamic ester in Brown et al. cannot form a three-dimensional structure, the dielectric material of Brown et al does not (implicitly or explicitly) have a number of <u>molecular level pores</u> inside such as in the present invention.

With regard to new claims 19-24, shown in the instant specification, pages 24-30 and Figures 7, 8A, the Brown et al reference contains no teaching or suggestion of these features.

Consequently, since the Brown et al reference fails to (explicitly or implicitly) disclose the above features of amended claims 6-10, 13 and 18-24, anticipation, under § 102(b), has not been set forth, and claims 6-10, 13 and 18-24 are therefore patentable over the teachings of Brown et al.

While the present application is now believed to be in condition for allowance, should the Examiner find some issue to remain unresolved, or should any new issues arise, which could be eliminated through discussions with Applicants' representative, then the Examiner is invited to contact the undersigned by telephone in order that the further prosecution of this application can thereby be expedited.

Respectfully submitted,

Donald R. Studebaker
Registration No. 32,815

Nixon Peabody LLP
8180 Greensboro Drive, Suite 800
McLean, Virginia 22102
(703) 770-9300
(703) 770-9400 fax

JLC/JWM

In accordance with the guidelines and waived provisions of 37 C.F.R. 1.121 promulgated in the USPTO announcement of January 31, 2003, please make the following amendments.

IN THE CLAIMS:

1. (Withdrawn)

2. (Withdrawn)

3. (Withdrawn)

4. (Withdrawn)

5. (Cancelled)

C1

6. (Currently Amended) The method for forming a semiconductor device of Claim 18, wherein the first cross-linking molecules are first organic molecules having three or more sets of functional groups in one molecule,

the second cross-linking molecules are second organic molecules having two sets of functional groups in one molecule, and

the three-dimensionally polymerized organic polymer is formed by ~~10~~ binding the three or more sets of functional groups of each of the first organic molecules and the two sets of functional groups of each of the second organic molecules together.

7. (Currently Amended) The method for forming a semiconductor device film of Claim 6, wherein the first organic molecules are represented by

[chemical formula 1]

$$
\begin{array}{c}
X_2 \\
| \\
X_1 --- R_1 --- X_1 \\
| \\
X_2
\end{array}
$$

(where R_1 is a first organic skeleton, X_1 is a first set of functional groups, and X_2 is a second set of functional groups, X_1 and X_2 being same or different in type),

the second organic molecules are represented by

[chemical formula 2]

$$Y_1 - R_2 - Y_2$$

(where R_2 is a second organic skeleton, Y_1 is a third set of functional groups, and Y_2 is a fourth set of functional groups, Y_1 and Y_2 being same or different. in type),

C1 cont

the three-dimensionally polymerized <u>organic</u> polymer is formed by binding the first set of functional groups (X_1) and the third set of functional groups (Y_1) together and binding the second set of functional groups (X_2) and the fourth set of functional groups (Y_2) together, and

the molecular level pores are formed in regions surrounded by the first organic skeletons (R_1) and the second organic skeletons (R_2).

8. (Currently Amended) The method for forming a semiconductor device of Claim 6, wherein the first organic molecules are represented by

[chemical formula 3]

$$
\begin{array}{c}
X_1 \\
| \\
Z --- R_1 --- X_2 \\
| \\
X_1
\end{array}
$$

(where R_1 is a first organic skeleton, X_1 is a first set of functional groups, X_2 is a second set of functional groups, and Z is a third set of functional groups, X_1 and X_2 being same or different in type),

the second organic molecules are represented by

[chemical formula 4]

$$Y_1 - R_2 - Y_2$$

(where R_2 is a second organic skeleton, Y_1 is a fourth set of functional groups, and Y_2 is a fifth set of functional groups, Y_1 and Y_2 being same or different in type),

the three-dimensionally polymerized organic polymer is formed by first binding the first set of functional groups (X_1) and the fourth set of functional groups (Y_1) together and binding the second set of functional groups (X_2) and the fifth set of functional groups (Y_2) together to form a plurality of units and then binding the third set of functional groups (Z) of the plurality of units together, and

C' cont

the molecular level pores are formed in regions surrounded by the first organic skeletons (R_1) and the second organic skeletons (R_2) in the plurality of units.

9. (Currently Amended) The method for forming a semiconductor device of Claim 18, further comprising the steps of:

~~forming an interlayer dielectric film comprising a three-dimensionally polymerized polymer having a number of molecular level pores inside, by polymerizing first cross-linking molecules having a three-dimensional structure and second cross-linking molecules having a two-dimensional structure;~~

forming a surface barrier film on the interlayer dielectric film;

forming a mask on the surface barrier film;

forming a concave portion in the surface barrier film and the interlayer dielectric film by etching the surface barrier film and the interlayer dielectric film using the mask; and

forming an interconnection made of a metal material by filling the concave portion with the metal material.

10. (Currently Amended) The method for forming a semiconductor device of Claim 9, wherein the first cross-linking molecules are first organic molecules having three or more sets of functional groups in one molecule,

the second cross-linking molecules are second organic molecules having two sets ~~of functional groups in one molecule, and~~

the three-dimensionally polymerized organic polymer is formed by binding the three or more sets of functional groups of each of the first organic molecules and the two sets of functional groups of each the second organic molecules together.

C' cont

11. (Canceled)

12. (Canceled)

13. (Amended) The method for forming a semiconductor device of Claim 18, further comprising the steps of:

~~forming an interlayer dielectric film comprising a three-dimensionally polymerized polymer having a number of molecular level pores inside, by polymerizing first cross-linking molecules having a three-dimensional structure and second cross-linking molecules having a two-dimensional structure;~~

forming a mask on the interlayer dielectric film;

forming a concave portion in the interlayer dielectric film by etching the interlayer dielectric film using the mask;

forming a sidewall barrier film on sidewalls of the concave portion; and

forming an interconnection made of a metal material by filling the concave portion having the sidewall barrier film with the metal material.

14. (Canceled)

15. (Canceled)

~~16. (Canceled)~~

17. (Canceled)

C1 cont.

18. (Currently Amended) A method for forming a semiconductor device, comprising the steps of:

polymerizing first cross-linking molecules having a three-dimensional structure and second cross-linking molecules having a two-dimensional structure to form an interlayer dielectric film composing a three-dimensionally polymerized organic polymer having a number of molecular level pores.

19. (New) The method for forming a semiconductor device of Claim 18, wherein the three-dimensionally polymerized organic polymer has a unit with diamond structure.

20. (New) The method for forming a semiconductor device of Claim 19, wherein the unit with diamond structure is composed of three hexagons sharing two sides with one another.

21. (New) The method for forming a semiconductor device of Claim 18, wherein the three-dimensionally polymerized organic polymer has a basket-like unit.

22. (New) The method for forming a semiconductor device of Claim 21, wherein the basket-like unit is composed of three hexagons sharing two sides with one another.

C' concl.

23. (New) The method for forming a semiconductor device of Claim 7, wherein the first organic molecules are adamantine derivatives, and the second organic molecules are benzene derivatives.

24. ~~(New) The method for forming a semiconductor device of Claim 8, wherein~~ the first organic molecules are benzene derivatives.